1. An apparatus for use in chemical mechanical polishing a substrate having a first surface and a second surface underlying the first surface, comprising:

a first optical system including a first light source to generate a first light beam to impinge on the substrate, the first light beam having a first effective wavelength, and a first sensor to measure light from the first light beam that is reflected from the first and second surfaces to generate a first interference signal;

a second optical system including a second light source to generate a second light beam that impinges the substrate, the second light beam having a second effective wavelength which differs from the first effective wavelength, and a second sensor to measure light from the second light beam that is reflected from the first and second surfaces to generate a second interference signal; and

a processor configured to determine a thickness from the first and second interference signals.

2. The apparatus of claim 1, wherein the first and second light beams have different wavelengths.

3. The apparatus of claim 1, wherein the first and second light beams have different incidence angles on the substrate.

4. The apparatus of claim 3, wherein the first and second light beams have different wavelengths.

5. The apparatus of claim 1, wherein the first effective wavelength is greater than the second effective wavelength.

6. The apparatus of claim 5, wherein the first effective wavelength is not an integer multiple of the second effective wavelength.

7. The apparatus of claim 1, wherein at least one of the optical systems is an off-axis optical system.

8. The apparatus of claim 7, wherein both the first and second optical systems are off-axis optical systems.

9. The apparatus of claim 7, wherein the first optical system is an off-axis optical system and the second optical system is a normal-axis optical system.

10. The apparatus of claim 1, wherein at least one of the optical systems is a normal-axis optical system.

11. The apparatus of claim 1, wherein at least one of the first and second light sources is a light emitting diode.

12. The apparatus of claim 11, wherein the first light source is a first light emitting diode having a first coherence length and the second light source is a second light emitting diode having a second coherence length.

13. The apparatus of claim 12, wherein the first coherence length is greater than a optical path length of the first light beam through a layer in the substrate, and the second coherence length is greater than an optical path length of the second light beam through the layer in the substrate.

14. The apparatus of claim 1, further comprising a polishing pad which contacts the first surface of the substrate.

15. The apparatus of claim 14, further comprising a platen to support the polishing pad, wherein the platen includes an aperture, and the first and second light beams pass through the aperture.

16. The apparatus of claim 14, further comprising a platen to support the polishing pad, wherein the platen includes a first aperture and a second aperture, and the first light beam passes through the first aperture and the second light beam passes through the second aperture.

17. The apparatus of claim 14, wherein the polishing pad includes a transparent window, and the first and second light beams pass through the window.

18. The apparatus of claim 14, wherein the polishing pad includes a first transparent window and a second transparent window, and the first light beam passes through the first window and the second light beam passes through the second window.

19. The apparatus of claim 1, wherein the first effective wavelength is greater than the second effective wavelength.

20. The apparatus of claim 19, wherein the first light beam has a first wavelength and the second light beam has a second wavelength that is shorter than the first wavelength.

21. The apparatus of claim 20, wherein the first wavelength is between about 600 and 1500 nanometers.

22. The apparatus of claim 20, wherein the second wavelength is between about 300 and 600 nanometers.

23. The apparatus of claim 19, wherein the first light beam has an incidence angle on the substrate that is less than a second incidence angle of the second light beam on the substrate.

24. The apparatus of claim 1, wherein the processor is configured to determine a first model intensity function for the first interference signal and a second model intensity function

for the second interference signal.

25. The apparatus of claim 24, wherein the first and second model intensity functions are sinusoidal functions.

26. The apparatus of claim 25, wherein the first model intensity function is described by a first period and a first phase offset, and the second model intensity function is described by a second period and a second phase offset.

27. The apparatus of claim 26, wherein the first period and the first phase offset are computed from a least square fit of the first model intensity function to intensity measurements from the first interference signal, and the second period and the second phase offset are computed from a least square fit of the second model function intensity to intensity measurements from the second interference signal.

28. The apparatus of claim 26, wherein the thickness may be estimated by a first model thickness function which is a function of a first integer, the first effective wavelength, the first period and the first phase offset, and by a second model thickness function which is a function of a second integer, the second effective wavelength, the second period and the second phase offset, and the processor is configured to determine a first value for the first integer and a second value for the second integer which provide approximately equal estimates of the thickness from the first and second model thickness functions.

29. The apparatus of claim 28, wherein the processor is configured to determine the first and second values by finding solutions to the equation:

$$M = \left(\frac{\Phi_2}{\Delta T_2} + N\right) \cdot \frac{\lambda_{eff2}}{\lambda_{eff1}} - \frac{\Phi_1}{\Delta T_1}$$

where M is the first integer, N is the second integer, λ_{eff1} is the first effective wavelength, λ_{eff2} is the second effective wavelength, ΔT_1 is the first period, ΔT_2 is the second period, ϕ_1 is the first phase offset, and ϕ_2 is the second phase offset.

30. The apparatus of claim 24, wherein the thickness may be estimated by a first model thickness function which is a function of a first integer, the first effective wavelength and the first interference signal and by a second model thickness function which is a function of a second integer, the second effective wavelength, and the second interference signal, and the processor is configured to determine a first value for the first integer and a second value for the second integer that provide approximately equal estimates of the thickness from the first and second model thickness functions.

31. The apparatus of claim 30, wherein the first model thickness function is a function of a first period and the second model thickness function is a function of a second period, and the processor is configured to determine the first period from the first interference signal and the second period from the second interference signal.

32. The apparatus of claim 31, wherein the first model thickness function is a function of a first phase offset and the second model thickness function is a function of a second phase offset, and the processor is configured to determine the first phase offset from the first interference signal and the second phase offset from the second interference signal.

33. The apparatus of claim 24, wherein the processor is configured to determine a relationship between a first model thickness function that is a function of the first effective wavelength and a second model thickness function that is a function of the second effective wavelength such that the first

and second model intensity functions provide approximately equal estimates of the thickness of the layer.

34. An apparatus for use in chemical mechanical polishing a substrate having a first surface and a second surface underlying the first surface, comprising:

a first optical system including a first light source to generate a first light beam to impinge on the substrate, the first light beam having a first effective wavelength, and a first sensor to measure light from the first light beam that is reflected from the first and second surfaces to generate a first interference signal; and

a second optical system including a second light source to generate a second light beam that impinges the substrate, the second light beam having a second effective wavelength which differs from the first effective wavelength, and a second sensor to measure light from the second light beam that is reflected from the first and second surfaces to generate a second interference signal.

35. An apparatus for chemical mechanical polishing a substrate having a first surface and a second surface underlying the first surface, comprising:

a platen to support a polishing pad which contacts the first surface of the substrate during polishing;

a first optical system including a first light source to generate a first light beam that impinges the substrate, the first light beam having a first effective wavelength, and a first sensor to measure light from the first light beam that is reflected from the first and second surfaces to generate a first interference signal; and

a second optical system including a second light source to generate a second light beam that impinges the substrate, the second light beam having a second effective wavelength that differs from the first effective wavelength, and a second sensor

to measure light from the second light beam that is reflected from the first and second surfaces to generate a second interference signal; and

a processor configured to determine a thickness from the first and second interference signals, wherein the thickness may be estimated by a first model thickness function which is a function of a first integer and the first effective wavelength and by a second model thickness function which is a function of a second integer and the second effective wavelength, wherein the processor is configured to determine a first value for the first integer and a second value for the second integer that provide approximately equal estimates of the thickness from the first and second model thickness functions.

36. An apparatus for use in chemical mechanical polishing a substrate having a first surface and a second surface underlying the first surface, comprising:

a first optical system including a first light emitting diode to generate a first light beam that impinges the substrate, the first light beam having a first effective wavelength, and a first sensor to measure light from the first light beam that is reflected from the first and second surfaces to generate a first interference signal; and

a second optical system including a second light emitting diode to generate a second light beam that impinges the substrate, the second light beam having a second effective wavelength that differs from the first effective wavelength, and a second sensor to measure light from the second light beam that is reflected from the first and second surfaces to generate a second interference signal.

37. The apparatus of claim 36, wherein the first light beam has a first wavelength and the second light beam has a second wavelength that is shorter than the first wavelength.

38. The apparatus of claim 37, wherein the first wavelength is between about 700 and 1500 nanometers.

39. The apparatus of claim 37, wherein the second wavelength is between about 300 and 700 nanometers.

40. The apparatus of claim 36, wherein the substrate has a layer in a thin film structure disposed over a wafer, and wherein the first and second light beams have coherence lengths sufficiently large to maintain coherence of the first and second light beams as they pass through the layer.

41. The apparatus of claim 40, wherein a first coherence length of the first beam is greater than an optical path length of the first light beam through the layer, and a second coherence length of the second light beam is greater than an optical path length of the second light beam through the layer.

42. An apparatus for detecting a polishing endpoint during chemical mechanical polishing of a substrate having a layer in a thin film structure disposed over a wafer, the substrate having a first surface and a second surface underlying the first surface, comprising:

a light emitting diode to generate a light beam that impinges the layer of the substrate, wherein the light beam emitted by the light emitting diode has a coherence length equal to or greater than the optical path length of the light beam through the layer;

a sensor to measure light from the light beam that is reflected from the first and second surfaces to generate an interference signal; and

a processor configured to determine the polishing endpoint from the interference signal.

43. An apparatus for detecting a polishing endpoint during

chemical mechanical polishing of a substrate having a first surface and a second surface underlying the first surface, comprising:

a first optical system including a first light source to generate a first light beam having a first effective wavelength that impinges the substrate, and a first sensor to measure light from the first light beam that is reflected from the first and second surfaces to generate a first interference signal; and

a second optical system including a second light source to generate a second light beam that impinges the substrate, the second light beam having a second effective wavelength that differs from the first effective wavelength, and a second sensor to measure light from the second light beam that is reflected from the first and second surfaces to generate a second interference signal; and

a processor configured to compare the first and second interference signals and detect the polishing endpoint.

44. An apparatus for measuring a thickness during chemical mechanical polishing of a substrate having a first surface and a second surface underlying the first surface, comprising:

means for generating first and second light beams having different effective wavelengths to impinge on the substrate;

means for detecting light from the first and second light beams that is reflected from the first and second surfaces to generate a first and second interference signals; and

means for determining a thickness from the first and second interference signals.

45. A method of determining a layer thickness for a substrate undergoing chemical mechanical polishing, comprising:

generating a first interference signal by directing a first light beam having a first effective wavelength onto the substrate and measuring light from the first light beam reflected from the substrate;

generating a second interference signal by directing a second light beam having a second effective wavelength onto the substrate and measuring light from the second light beam reflected from the substrate, wherein the first effective wavelength differs from the second effective wavelength; and

determining the thickness from the first and second interference signals.

46. The method of claim 45, wherein the determining the thickness includes includes determining a first model intensity function for the first interference signal and a second model intensity function for the second interference signal.

47. The method of claim 46, wherein the first and second model intensity functions are sinusoidal functions.

48. The method of claim 47, wherein the first model intensity function is described by a first period and a first phase offset, and the second model intensity function is described by a second period and a second phase offset.

49. The method of claim 48, wherein determining the thickness further includes computing the first period and the first phase offset from a least square fit of the first model intensity function to intensity measurements from the first interference signal, and computing the second period and the second phase offset from a least square fit of the second model function intensity to intensity measurements from the second interference signal.

50. The method of claim 48, wherein the thickness may be estimated by a first model thickness function which is a function of a first integer, the first effective wavelength, the first period and the first phase offset, and by a second model thickness function which is a function of a second integer, the

second effective wavelength, the second period and the second phase offset, and determining the thickness further includes determining a first value for the first integer and a second value for the second integer which provide approximately equal estimates of the thickness from the first and second model thickness functions.

51. The method of claim 50, wherein determining the first and second values further includes finding solutions to the equation

$$M = \left(\frac{\phi_2}{\Delta T_2} + N\right) \cdot \frac{\lambda_{eff2}}{\lambda_{eff1}} - \frac{\phi_1}{\Delta T_1}$$

where M is the first integer, N is the second integer, λ_{eff1} is the first effective wavelength, λ_{eff2} is the second effective wavelength, ΔT_1 is the first period, ΔT_2 is the second period, ϕ_1 is the first phase offset, and ϕ_2 is the second phase offset.

52. The method of claim 45, wherein the thickness may be estimated by a first model thickness function which is a function of a first integer, the first effective wavelength and the first interference signal, and by a second model thickness function which is a function of a second integer, the second effective wavelength and the second interference signal, and determining the thickness further includes determining a first value for the first integer and a second value for the second integer that provide approximately equal estimates of the thickness from the first and second model thickness functions.

53. The method of claim 52, wherein determining the thickness further includes determining a first period which describes the first interference signal and determining a second period which describe the second interference signal, and the first model thickness function is a function of the first period and the second model thickness function is a function of the second

period.

54. The method of claim 53, wherein determining the thickness includes determining a first phase offset which describes the first interference signal and determining a second phase offset which describes the second interference signal, and the first model thickness function is a function of the first phase offset and the second model thickness function is a function of the second phase offset.

55. The method of claim 45, wherein the first and second light beams have different wavelengths.

56. The method of claim 45, wherein the first and second light beams have different incidence angles on the substrate.

57. The method of claim 56, wherein the first and second light beams have different wavelengths.

58. A method of detecting a polishing endpoint during polishing of a substrate, comprising:

generating a first interference signal by directing a first light beam having a first effective wavelength onto the substrate and measuring light from the first light beam reflected from the substrate;

generating a second interference signal by directing a second light beam having a second effective wavelength onto the substrate and measuring light from the second light beam reflected from the substrate, wherein the first effective wavelength differs from the second effective wavelength; and

comparing the first and second interference signals to determine a polishing endpoint.